

# Controller Managed Spacing Study

E Operations Workshop

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# Controller Managed Spacing Study

## Objective

- Determine through fast-time and human-in-the-loop simulations how well controllers with and without trajectory based tools can cope with disturbances and manage spacing of arrival aircraft on RNAV RNP routes with optimized vertical profiles (i.e. CDAs).



# Road Map

- Trajectory Oriented Operations With Limited Delegation
- Continuous Descent Arrival analysis (TASAT) and field studies
- This study focusing on controller procedures and tools for managing spacing of arrival aircraft in a mid-term time frame (2015)
- Future studies will focus on super-density operations with controller tools and a fraction of aircraft equipped for airborne merging and spacing



# Operational Concept for Controlling Arrival Aircraft on RNAV RNP/CDA routes

A Mid-term 2015 Concept

Time-based metering provides runway arrival schedule and time constraint for inbound aircraft.

En route speed assignments delivers aircraft so they are correctly spaced for descending on the RNAV RNP/CDA route.

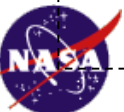
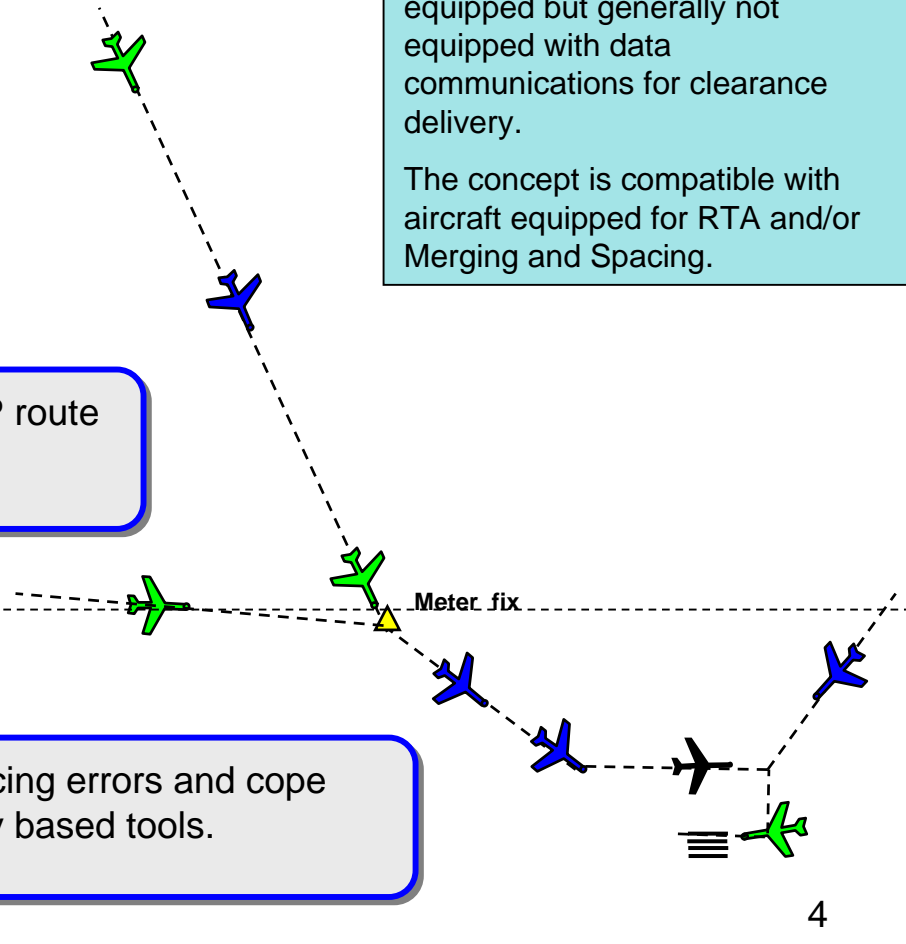
Flight crews fly VNAV descents along RNAV RNP route – largely without controller intervention.

Focus of this study:

TRACON controllers correct spacing errors and cope with disturbances using trajectory based tools.

Aircraft are assumed to be FMS equipped but generally not equipped with data communications for clearance delivery.

The concept is compatible with aircraft equipped for RTA and/or Merging and Spacing.



# RNAV RNP/CDA Design Goals and Issues

## (CDA = Optimized Vertical Profile)

- Altitude and speed restrictions to regularize the vertical profiles of arriving aircraft ... like the LAX RIIVR ONE
- Non-idle profile sections to allow speed control to adjust spacing ... like the SDF CDAs
- Airspace provided to allow lateral path adjustments
- Waypoints located to facilitate “direct-to” lateral fanning and base extension clearances
- Video map markers to aid controllers in no tools conditions ... like the LAX RIIVR ONE

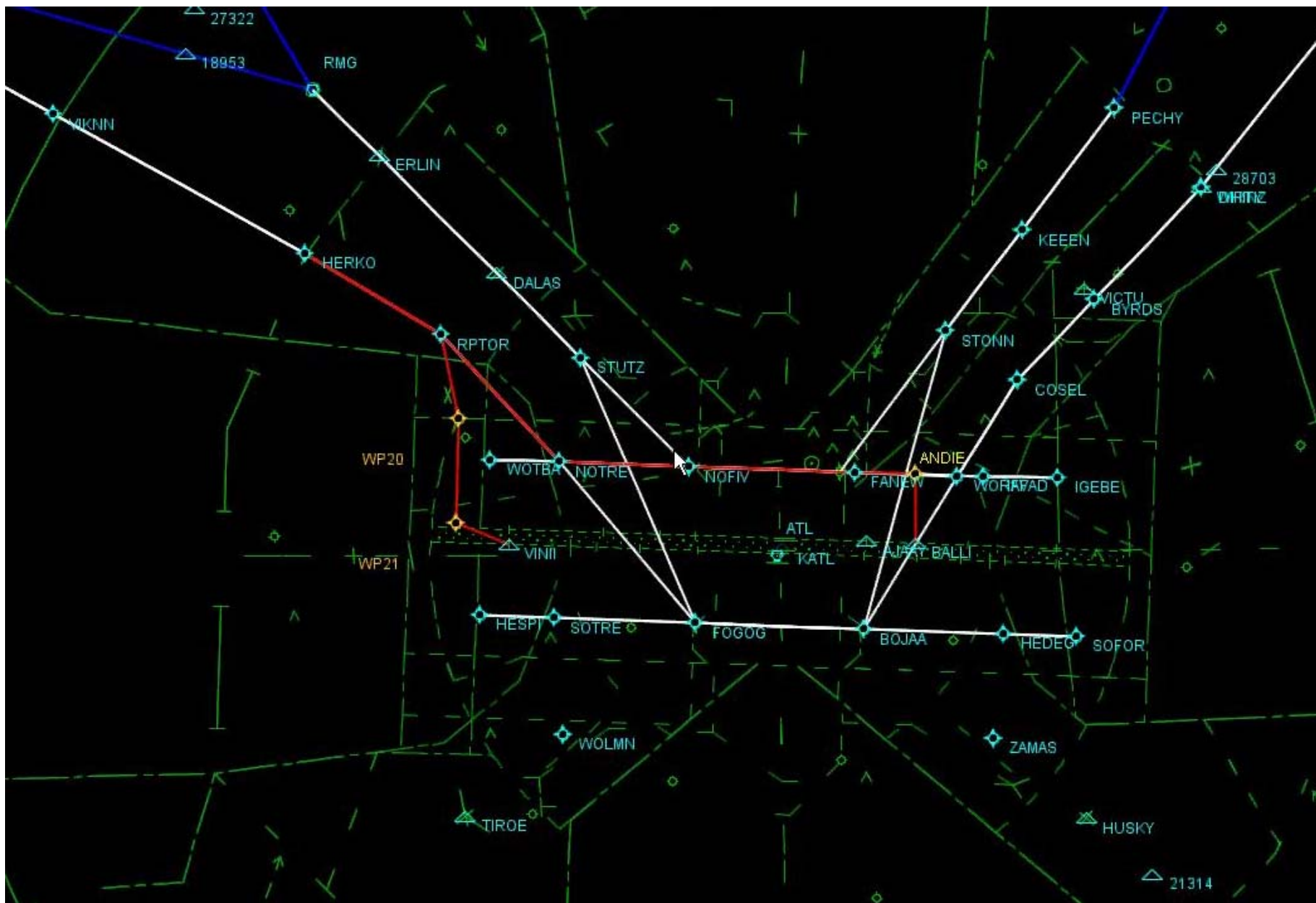


# FMS RNAV RNP/CDA Design for Spacing Control

- Start with existing CDA designs
  - ATL ... to coordinate with the ATL 1.5 and 2.0 CDA trials
  - SDF ... to coordinate with FDMS CDA trials
- Imbed these in RNAV routes for all ATL departures and arrivals
- Analyze the routes for spacing controllability
  - Required control for expected errors ...
  - Determine the range of disturbances that need to be dealt with.
- Define DOFs for speed and path control of spacing errors that are compatible with advisory tools



# HERKO CDA Arrival to ATL RWY 09R and 26R designed for the ATL 1.5 trials

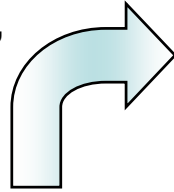




# Human-in-the-Loop Simulation

## Multi-Aircraft Control System (MACS)

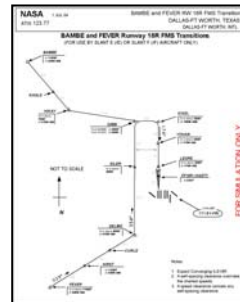
Standard voice com.,  
Data Comm, ASAS,  
Trajectory changes



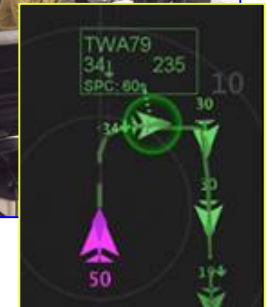
Pilot stations with  
state-of-the-art FMS  
and displays  
advanced CDTI,  
ASAS and data link



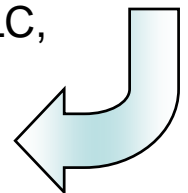
Controller stations  
emulating state-of-  
the-art and advanced  
surveillance,  
automation, and data  
comm capabilities



FMS procedures

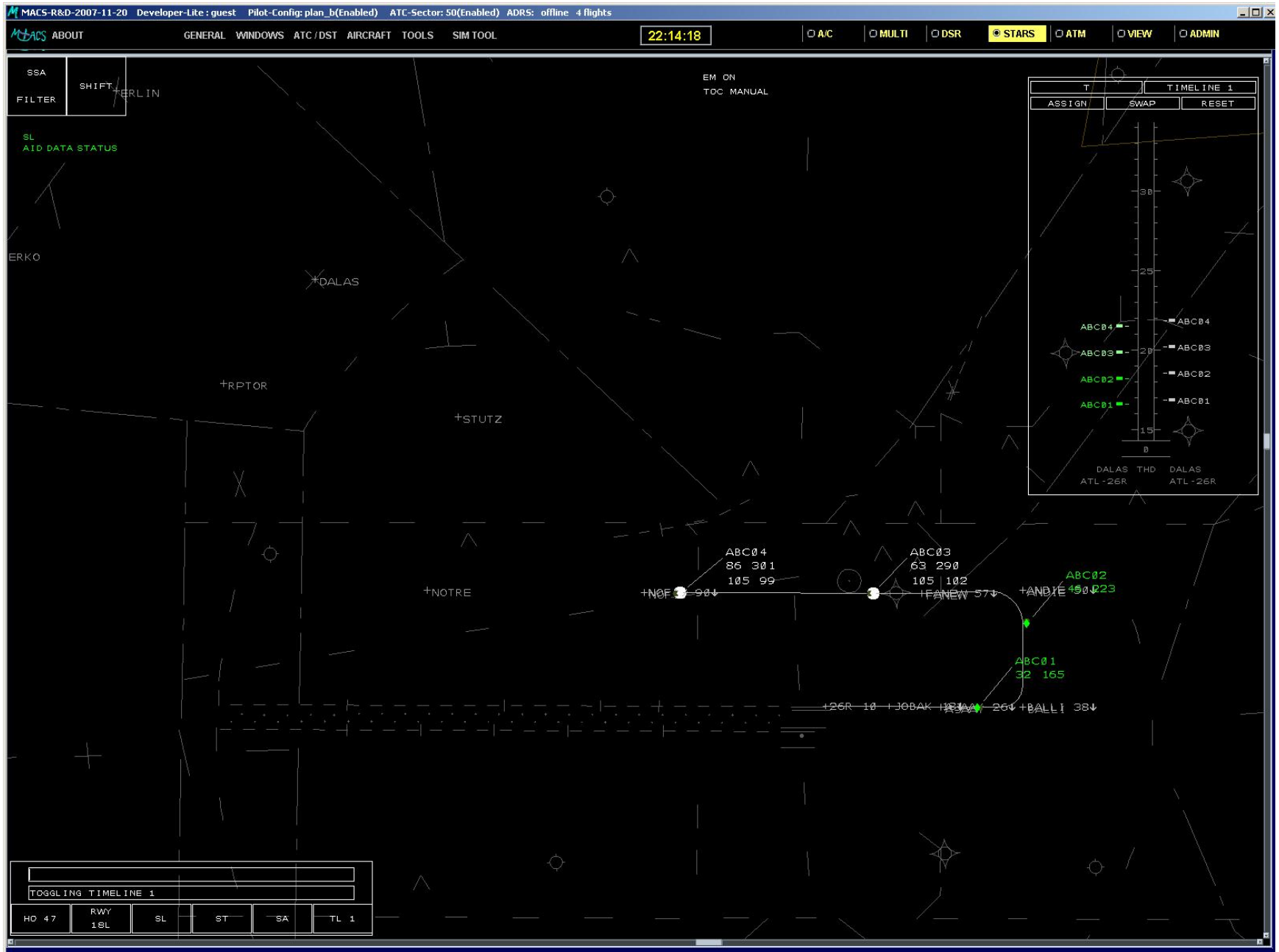


Standard voice com.,  
ADS-B, CPDLC,  
Trajectory  
requests





# MACS Emulated TRACON Controller Display



# Experimental Variables

- Type of controller tools and advisories
  - No tools
  - En Route sequencing with an Arrival Message
  - Runway based schedule with ETAs and STAs
  - Spacing circles
  - Speed advisories
  - Path and speed advisories
  - ...
- Magnitude of disturbances
- Aircraft type/equipage mixture
- Type of off-nominal situations



# Companion NASA NRA ... Transition to ASDO Capability

Focused on mid-term operational concepts  
for coping with off-nominal events

